BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, DC 20554

Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, as amended by the Broadband Data Improvement Act	)	GN Docket No. 09-137
A National Broadband Plan For Our Future	)	GN Docket No. 09-51
International Comparison and Survey Requirements in the Broadband Data Improvement Act	)	GN Docket No. 09-47

COMMENTS OF HONEYWELL INTERNATIONAL INC. ON NBP PUBLIC NOTICE #2

Honeywell International Inc. ("Honeywell") hereby submits its comments in response to the Public Notice issued by the Commission in the above-captioned proceedings.[1] Honeywell has over 100 years of experience in providing energy management solutions. Roughly 50 percent of our product portfolio delivers energy efficiency benefits. Honeywell Automation and Control Solutions division has completed more than 5,000 energy efficiency improvement projects for schools, cities and other government entities; these projects have delivered more than $4.5 billion in guaranteed energy and operational savings. Honeywell is one of the original partners of

[1] *See* Public Notice, *Comment Sought on the Implementation of Smart Grid Technology*, NBP Notice #2, DA 09-2017 (rel. Sept. 4, 2009).

the Clinton Climate Initiative to bring these energy efficiency programs to government buildings in major cities around the world.

Honeywell energy management technologies are found in more than 150 million homes, five million buildings, 24 of the top 25 refineries, and nearly 5,000 industrial sites around the world. By applying our expertise in sensing and controls, we are creating energy efficient, more comfortable, safer, more secure, and productive environments for our customers. For example, home owners typically reduce their heating and cooling demand by up to 30 percent using Honeywell's programmable thermostats. If Honeywell's energy efficiency technologies were immediately and comprehensively adopted, we could substantially reduce US energy demand by 15-20%.

In more than 25 years of working with the nation's utilities, we have deployed millions of one-way communicating demand management devices in homes, including switches to cycle air conditioning and communicating thermostats; these help lower peak electricity load by more than 1GW across the nation while maintaining consumers' comfort and reducing their electricity bills.

INTRODUCTION

The communications infrastructure needed for the smart grid can be categorized into the following four distinct domains:

1. Transmission of interval meter reading ("metering domain") for
    a. accurate real-time billing to implement variable pricing offerings to customers; and

b. two-way electricity metering (net metering) to enable distributed generation/storage to feed back into the grid

2. Communications infrastructure that interconnects utility bulk generation, transmission and distribution resources (e.g., substations) to enable control of this infrastructure ("T&D domain")

3. Communication between the utility and the customer for such energy services as demand response, PHEV charging control, use of distributed resources for frequency regulation, etc. ("utility to customer information network domain" or "UCIN domain")

4. Customer premises networking for coordinating amongst various energy consumption, generation and storage devices in homes, commercial buildings and industrial facilities ("customer premises domain," which includes the home area network or HAN)

Honeywell's comments focus particularly on domains 3 and 4 (UCIN and customer premises), but we also address domain 1 (metering) because there is often conflation between the metering domain and the other two.

Honeywell recommends the following broad principles for designing a smart grid communications policy:

1. Networks and energy management technologies will evolve over time. To allow for innovation on both sides of the meter, we should establish a clear demarcation point between utility networks and customer premises equipment. This is similar to the

telecommunications industry, where establishment of a demarcation point between the telephone company and the home allowed for competition and innovation in phone devices (memory / speed-dial buttons, screens, cordless phones, answering machines, faxes, etc.) and also allowed telephone networks to evolve. This principle will eliminate any conflation between the customer premises domain and the other domains (particularly UCIN and metering) and allow each domain to evolve independently.

2. Separate the flow of electric power from the flow of information. In a way, this is similar to how the telephone system evolved over time, where the signaling network (e.g., SS7) became separate from the voice transport. Meters carry and measure electricity flow to/from the customer. There should be a separate channel of communication between the customer premises and the utility to allow new energy management services to emerge and the grid to become increasingly smarter without the need to continuously change the metering infrastructure (which has a long replacement cycle). This principle will eliminate any conflation between the metering domain and the UCIN domain.

3. Commercially available networks are adequate for communication between utilities and customer premises. Broadband access is available to over 92% of the US population and cellular coverage is available to 99% of population. These commercially available networks are managed by experts at very high reliability and provide access to large amounts of bandwidth and differentiated quality of service. These networks should be utilized for offering energy management services to customer premises.

    a. The metering infrastructure should be specifically designed for and dedicated (restricted) to reading meters; it should not be used as part of or for relaying information (other than aggregate usage data) to the home area network (HAN). This approach (separation of metering and UCIN domains) will allow for independent and rapid evolution of energy management services using existing networks and communications devices without AMI networks becoming a capacity bottleneck.

b. The customer premises network (e.g., HAN or network for commercial building) should explore the potential use of dedicated spectrum; Honeywell has experienced interference and signal quality problems with unlicensed ISM bands, especially in 2.4GHz.

4. The decisions about networking and allocation of communication resources should be reached in conjunction with a robust energy management architecture design. For example, in the case of home energy management, if we specify a home energy manager as an information aggregation and decision making hub, then each individual device in the home will not need to communicate with the utility individually. The resulting architecture reduces communication (bandwidth) requirements and provides an application level demarcation between home appliances / devices and utilities to allow for innovation in home energy management. This architecture also alleviates privacy concerns for consumers.

SUITABILITY OF COMMUNICATIONS TECHNOLOGIES

Requirements: The metering domain requires low bandwidth and can tolerate high latency. The T&D domain requires low latency for applications like synchrophasors. The requirements for the UCIN domain vary by application. For example, demand management for peak load reduction through direct load control requires low bandwidth whereas managing the same distributed resources for ancillary applications like frequency regulation requires much higher bandwidth and lower latency. Similarly, PHEV charging will require high bandwidth and low latency.

Current Deployments: In the UCIN domain, pager networks are used extensively for residential demand response programs in North America. Commercial customers typically use broadband. Powerline carrier technologies are also in use.

Emerging Applications: Commercially available broadband and cellular networking technologies are sufficient for future UCIN communications. Most of the businesses and households now have broadband access (DSL, cable, municipal WiFi, WiMax, etc.) which provides adequate bandwidth for smart grid related communications between utilities and end customers. 2G cellular coverage is also ubiquitous. Moreover, both broadband and cellular networks are successfully supporting new applications in voice, data, and video transport to multiple devices in customers' homes and can easily accommodate additional traffic for the smart grid. In fact, as cellular traffic moves from 2G to 3G networks, significant amounts of bandwidth are becoming available at attractive prices for smart grid communications between a utility and its customers (UCIN domain). As these networks are shared with other Internet applications (web browsing, video download, gaming, email, voice, etc.), costs are amortized across multiple applications and the smart grid can utilize these professionally managed networks at attractive/low prices.

Metering networks use commercially available networks at least for backhauling traffic. Sometimes they use these networks down to the individual meter and sometimes only to a concentrator, with a dedicated, low-capacity mesh network from the concentrator to the individual meter. Investing in dedicated AMI networks to also carry UCIN traffic is meaningless, since there are already commercially available networks for that purpose; the increased capacity required to accommodate UCIN traffic over metering networks will eliminate the cost advantage (if any) that these dedicated networks may have for very low volume metering traffic, will unnecessarily saddle ratepayers with the cost to duplicate existing infrastructure and will delay reaping the benefits of the smart grid.

Commercially available technologies are also sufficient for the T&D domain, where cellular 2G networks and fiber networks are used extensively for backhaul of substation SCADA data. Some utilities have also set up proprietary networks in the 700MHz analog TV band.

Reliability: The professionally managed commercial wireless networks can be provisioned to provide differentiated QoS in order to accommodate the reliability requirements of different applications. Commercial networks are already used for operating critical national infrastructure. For example, the AT&T public network carries Air Traffic Control data for the FAA. The air traffic system is designed to have fail-safe local control of single aircraft as well as redundant communications mechanisms between aircraft and to the ground.

Similarly, the smart grid architecture can add such redundancy and robustness. On the energy flow side, distributed resources will allow for islanding and isolation of faults avoiding large scale blackouts. On the information flow side, the availability of multiple networks to customer premises (broadband, cellular) provides redundancy; in addition, the metering network can be used as an emergency communications mechanism.

We suggest that metering networks should be designed for carrying meter readings from customer premises to the utility back office and be provisioned for emergency backup communications to customers. This will allow for a quick and cost effective deployment of advanced metering while energy management services can simultaneously be developed and deployed using commercial networks and communications devices. Commercial networks are continuously upgraded for rapid growth of Internet applications such as banking, gaming and smart mobile devices. Smart Grid applications can benefit from this independent evolution of commercial networks by offering advanced energy management services without being hampered by the slow deployment and evolution of proprietary utility networks.

AVAILABILITY OF COMMUNICATIONS NETWORKS

Commercial networks can be used today to offer customers such smart grid energy services as energy conservation, demand response, etc. In fact, today's demand response based on direct load control is offered using commercial pager networks; also, utilities in California have successfully tested automatic demand response for commercial buildings using commercially available broadband.

Homes consume 40% of the electricity generated in the US; commercial buildings and industrial customers consume the remaining 60% of electricity. Virtually all commercial and industrial customers have broadband/cellular connectivity. 92% of households have access to broadband and 99% of households have access to cellular. These networks are adequate for UCIN communications to implement smart grid applications.

The availability of existing commercial networks is a great enabler for the smart grid. These networks are professionally managed and are continuously upgraded to carry new Internet applications. This allows for rapid evolution in smart grid energy management. Smart grid applications (UCIN domain) can evolve without worrying about the networks necessary to carry information.

We recommend that metering networks, if deployed separately from commercially available infrastructure, should be limited to carrying real-time meter data back to the utility for billing in a variable pricing environment. All energy services can be provided using commercially available networks; there should be no conflation between the metering and UCIN domains.

If utilities choose to carry all communication to customers (UCIN domain) using dedicated metering networks such as AMI (metering domain), then the nation will have to wait for the build-up of such networks before benefiting from the smart grid and users will be subsidizing yet another network to their homes while there are already multiple low latency high bandwidth networks available. Thus, the conflation of the metering and UCIN domains is highly undesirable. Using existing networks will allow for faster and economical deployment of smart grid technologies, which will benefit from the amortization of the cost of commercial networks over thousands of applications.

The T&D domain will require additional communication resources especially for new applications such as synchrophasor based wide area surveillance, monitoring and control. Commercial networks (broadband, cellular, fiber) are adequate and available at most of the infrastructure locations. In some cases utilities/regions are investing in new networks – e.g., 1800MHz WiMax for Ontario province in Canada or municipal Wi-Fi in Tallahassee. These approaches will be sufficient to implement the smart grid.

SPECTRUM

Applications in the customer premises domain (e.g., HAN, building control network) use unlicensed spectrum in the 900 MHz and 2.4GHz bands.

Early demonstrations of home area networking applications using 2.4GHz IEEE 802.15.4 radios (the radios used by Zigbee) have experienced a lot of problems from interference with other devices such as cordless phones, microwave ovens, etc. Such interference and range coverage problems with Zigbee radios will get amplified in a nationwide deployment across multiple housing construction types (wooden, brick, stone houses, etc.) and different climatic zones.

Honeywell has successfully deployed home area networking for its advanced thermostats / comfort controllers using a 900MHz narrowband frequency hopping network with star topology achieving good point-to-point connectivity. This has eliminated interference with other devices. The 900MHz radios have also allowed us to achieve high reliability, low latency communications in all types and sizes of residential building construction and in all climate conditions.

With the expected rapid increase in the number of smart devices within homes and commercial buildings, we suggest that some lower frequency spectrum (900MHz or below – possibly one of the analog TV channels freed up during DTV transition) be dedicated to home area networking.

REAL-TIME DATA

Most of the current smart meter deployments provide aggregate household energy consumption measurements at one hour intervals; some AMI networks are being designed for 15 minute interval readings.

A meter measures energy consumption, so it can provide awareness to customers, e.g., through an in-home display. However, this awareness is limited, since the meter provides only aggregate consumption data. Customers may need finer consumption granularity at the level of individual loads (e.g., lighting, air-conditioning, pool pump, electric water heater) to understand the impact of their lifestyle and make behavior modifications.[2]

However, even if more granular consumption data were available, it is unlikely that consumers would want to spend their lives in front of an energy display. Many studies in the literature indicate that customers' response to pricing signals lacks completeness (customers forget to react), consistency (customers do not always take the same action) and persistence (customers' attention to energy prices attenuates over time).

As Secretary of Energy Dr. Steven Chu mentioned in his remarks at the GridWeek Conference in Washington, DC on September 21, 2009, customers need control devices with very simple interfaces for specifying the desirable level of economizing; these devices will make decisions automatically on behalf of the customer.

To ensure a sound architectural design, individual devices inside a house should neither communicate detailed individual device level energy data over the Internet nor be directly

[2] Analytic techniques can infer some level of load granularity from aggregate data, but their accuracy is limited.

controlled over the Internet. The architecture should provide for a hub (home energy manager) to enforce application demarcation. The home energy manager can collect consumption data from multiple loads and the meter automatically, receive pricing signals from the utility and implement efficiency measures automatically based on customer-specified preferences and policies. This allows for innovation inside the house as well as in pricing structures while addressing privacy concerns; furthermore, it does not require large bandwidth on communication networks.

The best method for customers to access consumption data is for the home energy manager or display (part of the customer premises domain) to communicate with the meter and retrieve the data. Since the meter is located in physical proximity to the home energy manager, the meter can be read directly by the home energy manager, provided there is a well known interface to the meter.

The utility needs to backhaul some of this data for billing purposes, so the utility can make such data also available on its web site for the customer to access. Yet another alternative is for the utility to make the consumption data available to a third party service provider, which will in turn present the data to the customer (e.g., through some web portal) and may also offer additional services.

The direct access of the meter by the home energy manager is superior to the other alternatives. First, it allows the home energy manager to access the meter data on demand – at the time when the home energy manager chooses and with the frequency which the home energy manager chooses; this flexibility allows finer energy controls. Second, it avoids the use of bandwidth for backhauling the data to the utility (particularly if the meter is read at high frequency). Last but not least, it keeps the data under the customer's control and avoids privacy concerns. Even at the aggregate level, detailed energy consumption data can provide highly sensitive information, e.g., occupancy of a home, which, in turn, may have serious ramifications for customers' security. The issue becomes much more severe if the information is at the individual load granularity (e.g., plasma TV), as some proposed standards and architectures are envisioning.[3] Many customers feel very uncomfortable about the availability of this data to third parties. If consumers choose to make their detailed data available to third parties, they can always do so by utilizing their home broadband connection at their own risk and expense – there is no reason to burden ratepayers with the cost of backhauling such data over the metering or the UCIN domain.

Pricing: Multiple pricing and load management scenarios have been tested by various utilities (e.g., BG&E study in 2008 & 2009). Pilot studies have examined the efficacy of a gamut of pricing schemes: simple two-tier time of use, multi-tier time of use, time of use with critical peak pricing, peak time rebate, real-time pricing. The studies in the literature indicate that complexity for the customers needs to be taken into account; relatively simple schemes can reap most of the benefits.

HOME AREA NETWORKS

We recommend that smart meters should carry only energy usage measurement data to the utility back office for billing.[4] The home energy manager should be able to read usage directly from the meters. All other energy management services should use commercially available networks for the UCIN domain. This architecture follows the well established telecom

[3] Secure transmission (e.g., encryption) of consumption data does not alleviate the problem. The biggest threat stems from the availability of the data at another site and the concomitant vulnerability over a long period of time, not from the instantaneous presence of the data on the network.

[4] The metering infrastructure can also provide emergency backup communications.

industry practice of separating the payload (voice traffic, analogous to electric power flow) from network control (signaling, analogous to smart grid signals).

We do not recommend that detailed individual device data be communicated over the Internet. Individual devices do not need to be controlled over the Internet, either. This is not a scalable architecture and such detailed information is not necessary for the utilities to optimize their networks. The utilities do not need to know if the load is coming from a dishwasher or a dryer to effectively manage the grid. The home energy manager should communicate only aggregate usage, generation and storage data to the utility. This will ensure privacy while it is adequate to manage the smart grid.

Let us look at an example from the Internet domain: individual IP-enabled home devices (computers, printers, game consoles, etc.) do not individually connect to the Internet. They instead use a firewall and gateway such as a cable or DSL modem. Similarly, we recommend the establishment of a home energy manager which can get real-time usage from the smart meter and communicate aggregate household information over the Internet for obtaining energy management services.

All types of smart devices will be connected to the home energy manager: appliances, pool pump controllers, thermostats, consumer electronics, energy displays, renewable generation, storage, etc. The home energy manager should be responsible for distributing pricing signals to all devices within the home, collecting responses from those devices, implementing energy saving policies specified (pre-programmed) by the user, etc.

CONCLUSION

Current commercially available networks have adequate bandwidth and latency characteristics for emerging smart grid applications. These networks currently support bandwidth intensive applications such as real-time video downloads and interactive multi-player gaming. They are clearly adequate for energy management services; their natural evolution to support our networked lifestyle will be a benefit to the smart grid without additional investment in dedicated infrastructure such as metering networks and without the concomitant burden on ratepayers.

Of paramount importance for the smart grid is the design of a scalable, robust architecture that will provide separation between the various communication domains and allow the independent and rapid evolution of new technologies and services in each domain.

Respectfully submitted,

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